D6

Conservation Implications of Golden-winged Warbler non-breeding ecology in a forest-agriculture mosaic, Costa Rica

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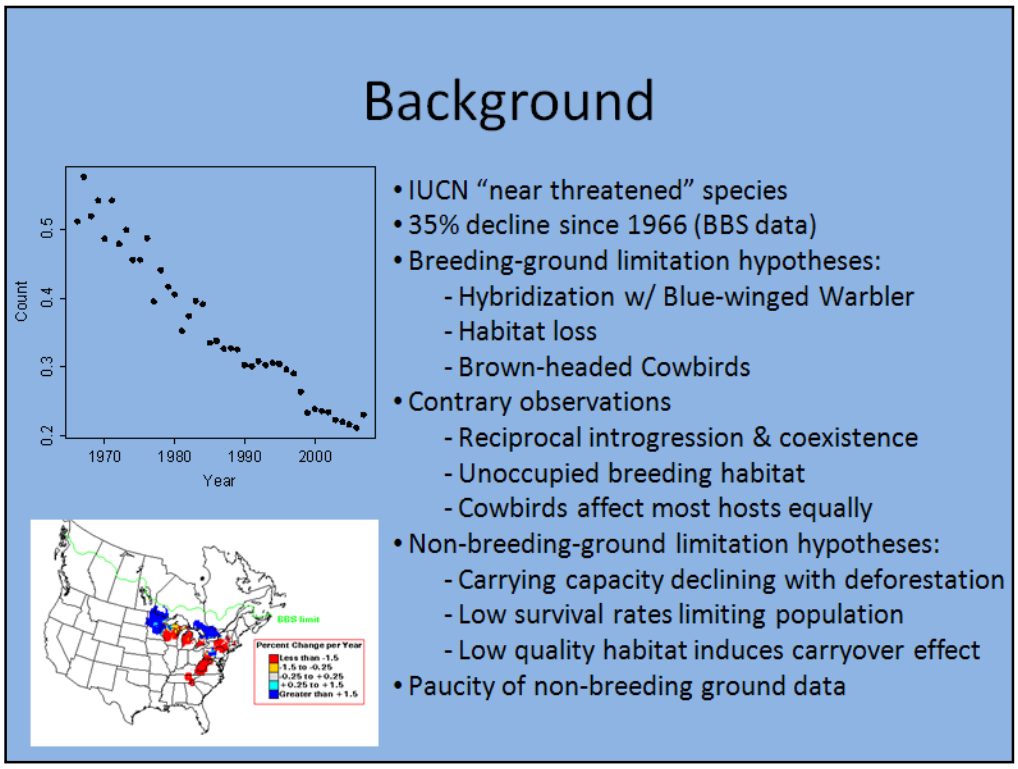
Thanks for coming. I'm going to present results from our work with Golden-winged Warblers in Costa Rica that we began a couple of winters ago. This project is part of a larger study of bird conservation and ecology in tropical agricultural landscapes. I'd like to first recognize my coauthors, my adviser Dave King and my wife Carly.

Slide 1

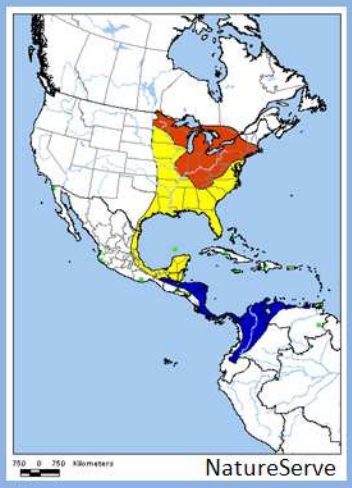
D6 Clarify relationship between distrubance-dependence and specilization.
Richard, 8/6/2008



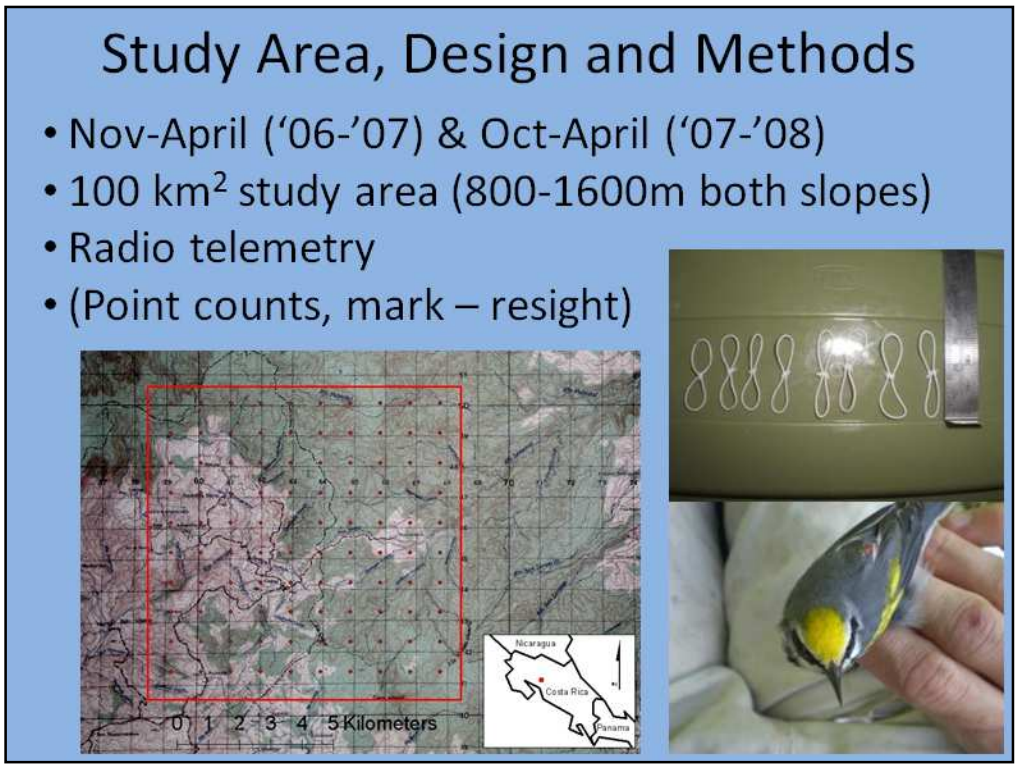
Most of you know that GWWA populations are declining at an alarming rate. These BBS data show a drop of ~35% over 40 years and the map shows where these declines have been most rapid. This species has been studied for decades on the breeding grounds and 3 non-exclusive hypotheses have been proposed to explain this decline. [Read them]. Each of these factors undoubtedly has negative effects on this population, however, we're far from being able to claim that any of these are responsible for the decline. The reasons being that we simply don't have the demographic data to make that claim yet, and there exist conflicting observations such as [read them]. Furthermore, we have virtually no data from the non-breeding grounds where this species spends twice as much time each year. This is concerning because we know that overwinter survival rates can greatly affect population viability. Furthermore, populations can be regulated by carrying capacity on the non-breeding grounds and finally, we know that habitat quality during the winter can affect fitness during migration and the breeding season.

Objectives

- Quantify aspects of non-breeding ecology relevant to conservation
  - Habitat use and selection
    - Foraging behavior
    - Mixed species flocking
  - Social system
  - Home range size
  - Survivorship



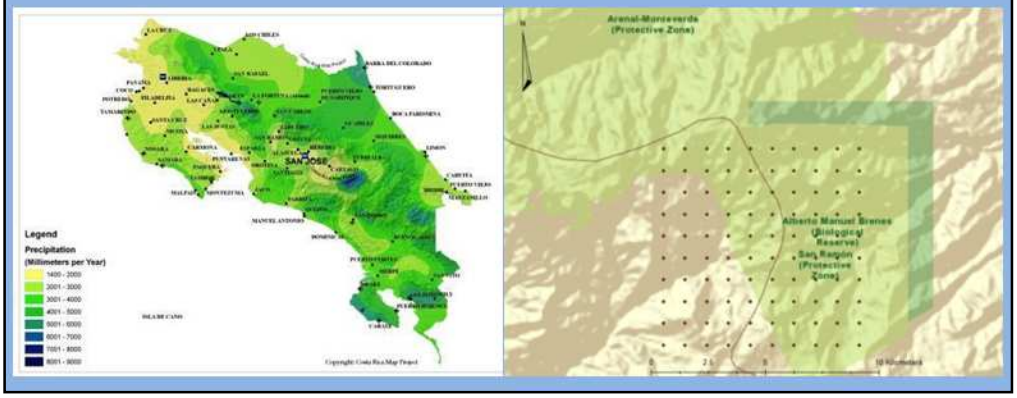
Because so little is known about GWWA during the non-breeding season, the focus of our study is to quantify aspects of their ecology relevant to conservation. Specifically, we want to understand habitat use and selection as well as potential mechanisms driving habitat use such as foraging requirements and mixed-species flock dependency. We're interested in social system because territoriality and sexual segregation are known to affect area requirements and the distribution of NTMBs. Home range size is also important in understanding spacing and habitat quality. Finally, we only have overwinter survival rates for a handful of NTMBs and several recent demographic sensitivity analyses have highlighted the importance of this parameter to population viability. Today, I'm going to briefly touch on each of these points rather than go into detail about any particular one.



Our study area is located in the Tilaran mountains along the continental divide between 800 and 1600 m. It's a great place to study these birds because its provides a variety of habitats, microclimates, and land use types to work in. The gradient in habitat conditions and microclimate is caused largely by a strong rain shadow effect due to the northeasterly trade winds. We work in both private agricultural lands as well as in the 30,000 ha+ reserve system that you can see here that includes the Monteverde Cloud Forest Reserve and the Manuel Brenes Reserve. The agricultural portion of the study area is largely deforested and only small fragments of primary forest and secondary forest remain. Today I'm going to be talking primarily about our radio-telemetry data, though we are also conducting point counts over the entire study area and using mark-resight methods. We're using Holohil transmitters that weigh just under 0.5g and we put them on with backpack harness we make out of elastic string.

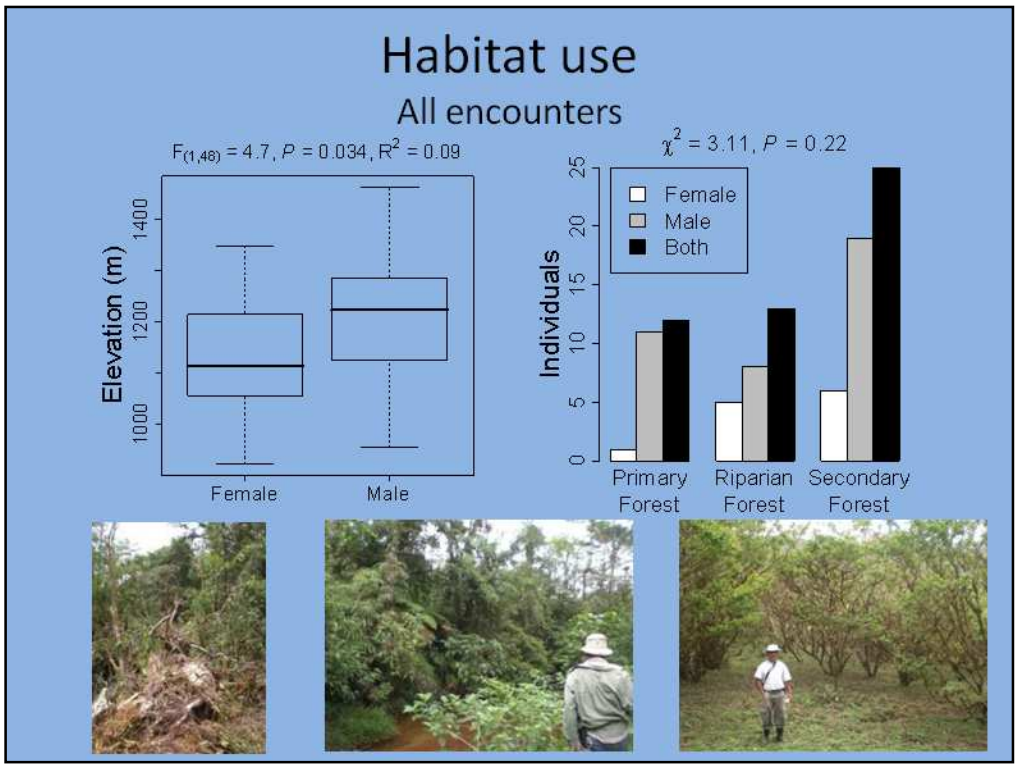
Winter distribution and habitat use in Costa Rica

- Absent from dry lowlands
- Uncommon in Caribbean and south Pacific lowlands
- Most abundant in premontane moist to wet forests

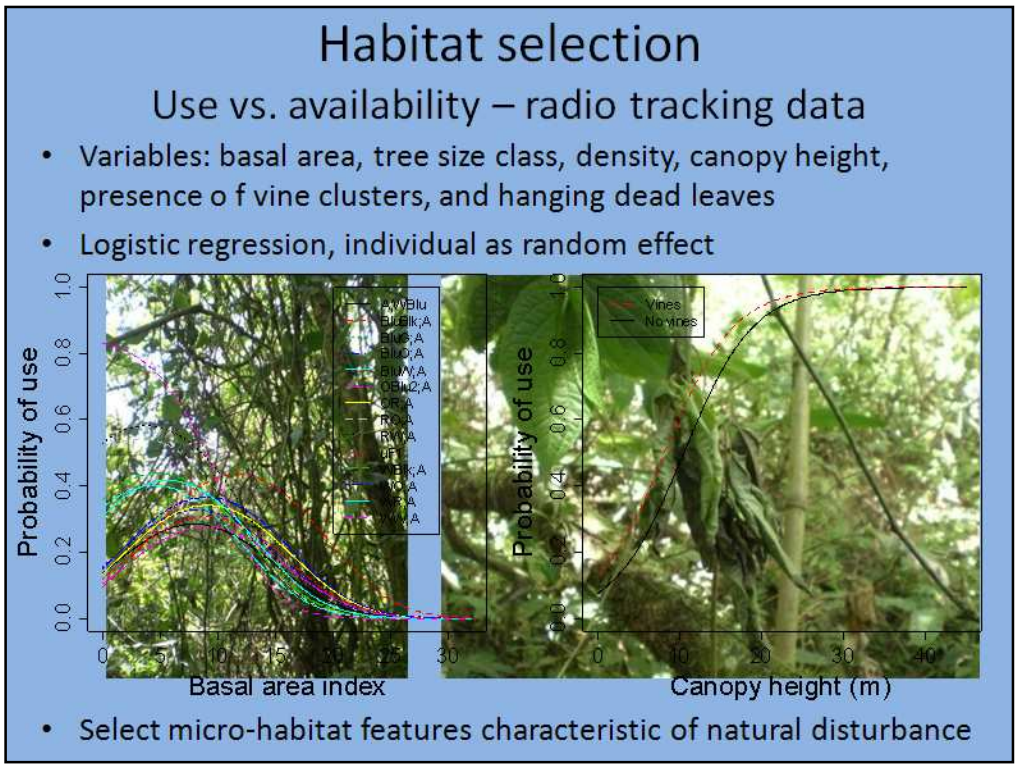


I want to briefly mention GWWA distribution throughout the country which we know about from the notes of Gary Stiles and Alexander Skutch. They appear to be absent from the dry lowlands of Guanacaste and the highlands above 2500m or so. They do occur in the wet lowlands but apparently are uncommon. Most sources report that they are most often encountered in the seasonal premontane evergreen forests. This is where our study area is located.

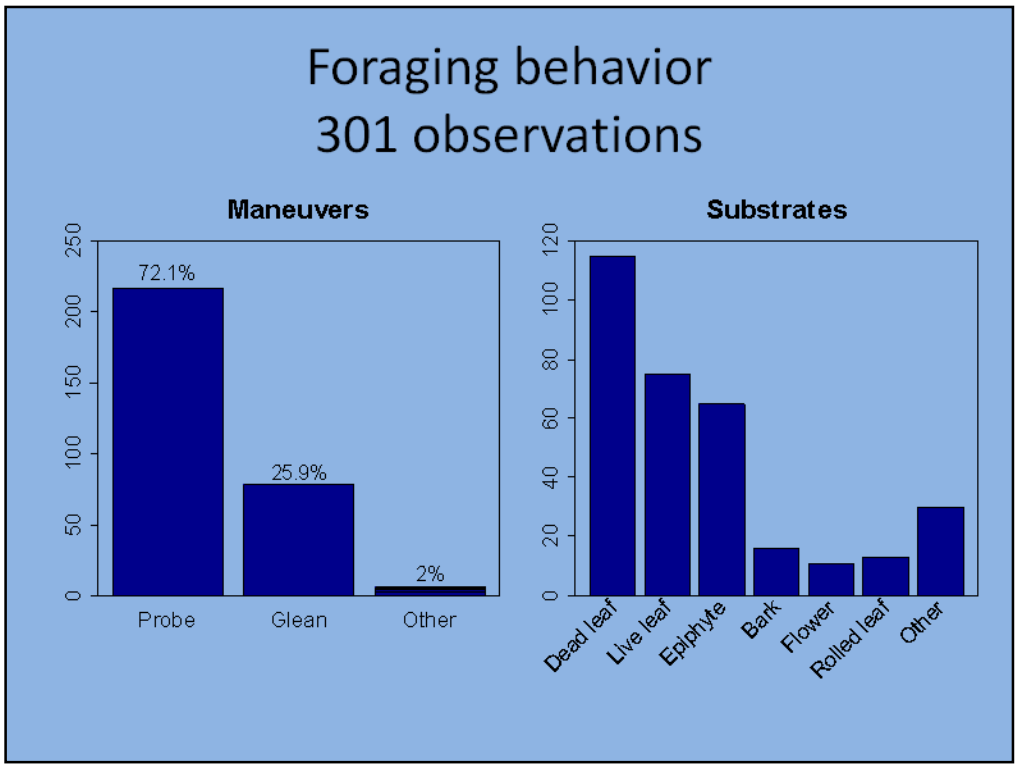
CR Nat History: La Selva=Un4cde, Osa=Un4cde, Palo Verde=Rt4bc, Santa Rosa=Ut4bcf, Las Cruces=Cn4b-e, Monteverde=Cn4acde, UCR=Utn4acd, Villa Mills=Do not occur



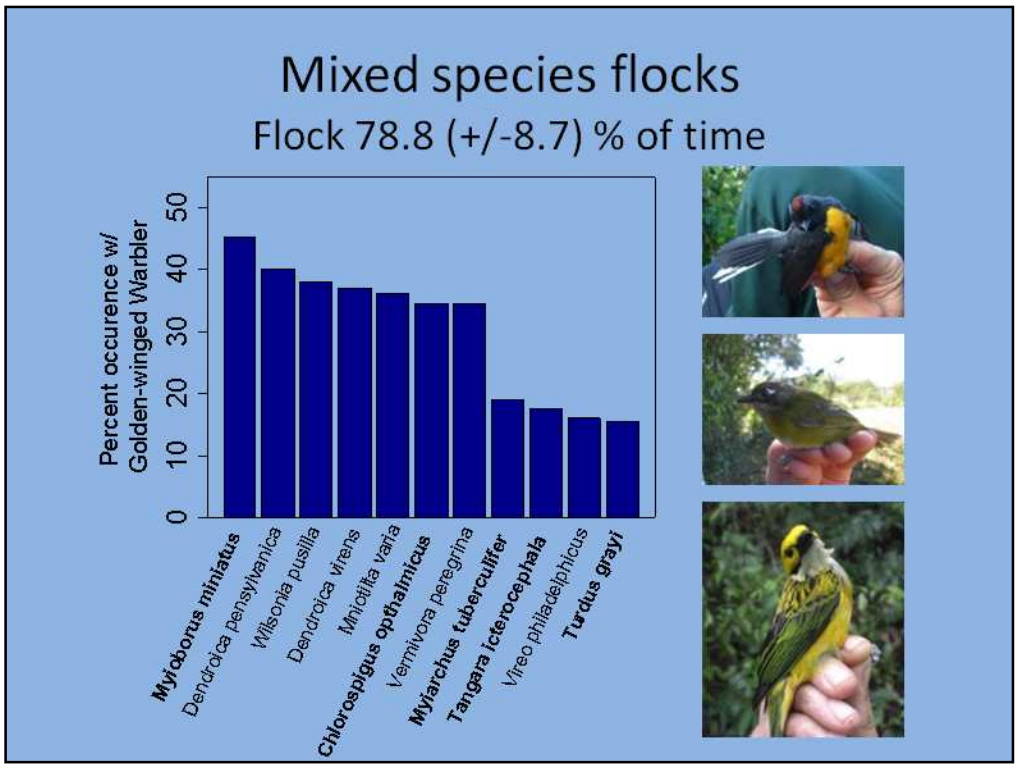
Within our study area we see a similar pattern to the one reported for the country at large. We do not find GWWA in the lower drier areas on the Pacific slope and we don't encounter them in the moss-laden high cloud forest. To give you a general sense of where we do find them, I have tabulated all our encounters and stratified them by habitat type. Note that this is not standardized by effort. Although we have encountered more males than females in primary forest, there is no significant difference here suggesting that sexes do not segregated by habitat. These pictures give you an idea of these broad habitat classifications. When we find them in primary forest, it's usually around large disturbances such as tree fall gaps and landslides. Riparian habitats are also often used, such as the one seen here which is about a six hour hike from the nearest dirt road. Finally, they will use secondary forest including regenerating pasture like this, in each case they have used adjacent mature forest as well. The boxplots on the right show that we have encountered males at higher elevations than females, though I'm not convinced that they segregate by elevation yet, our standardized surveys will help clarify this result. I primarily want to show that these birds appear to be constrained to a narrow elevational gradient in our study area, which I believe is due to variation in precipitation.



Moving on to our radio telemetry data. Our tracking protocol involves following each bird for approx 2 hours/day each day it is on the air. We record vegetation measurements and coordinates at point spaced at 30 min intervals, which we use in use vs availability analyses. These measurements include tree density, size class, basal area, canopy height as well as micro-habitat features such as the presence of vine tangles and the number of dead hanging leaves within 2m. To quantify availability, we conduct the same measurements at evenly spaced points throughout the bird's home range. We then use logistic regression to test for differences between used and available points, and we model variation among individuals as a random effect. We went through a model selection procedure and found the following supported relationships. The x-axis shows an index of basal area and the y-axis shows the probability of use. Each line represents an individual GWWA. What we see is that, within a home range, GWWA were more likely to use areas where basal area was intermediate. That is, the avoided areas with very low and very high basal area. This second plot shows the same thing except the x-axis is canopy height and I didn't present the variation among individuals. You can see that the probability of use increased with canopy height, and was higher where vine clusters were present. We interpret these findings to suggest that within a home range, GWWA select micro-habitat characteristics associated with disturbance.



Foraging requirements can influence habitat selection if a species is dependent upon certain substrates or prey items. These 2 barplots show the number maneuvers and substrate types recorded for some 300 foraging observations. You can see that probing is the primary foraging maneuver, and that most probing is into hanging dead leaves as well as epiphytes. They also will glean off the upper and undersides of live leaves. When they are probing dead leaves you can often hear them from a distance, which is one way we locate them while tracking. We find high levels of arthropods in these leaves, especially spiders, small cockroaches, and silverfish.



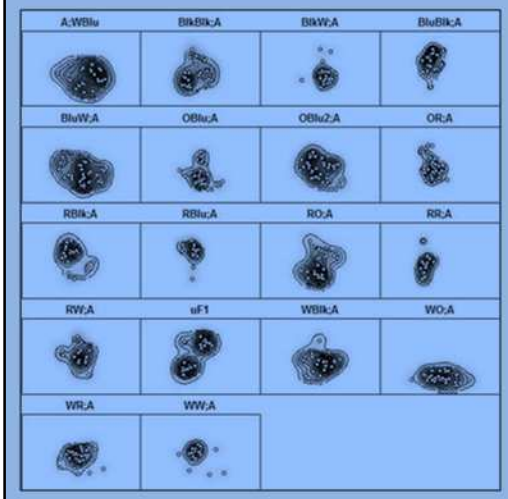
GWWA often occur with mixed-species flocks. These flocks are typically made up of both resident and migrant birds. This barplot shows the most common species that GWWA associate with in mixed species flocks. 5 of 11 are resident species. We've noticed that flock composition changes with habitat type indicating that there is no one species that GWWA depend upon, but rather their home ranges seem to always include areas where large flocks occur. At this point it's impossible to say the extent to which habitat selection is due to flock presence, but that is something we'd like to investigate further. Nonetheless, it is striking that each bird we've tracked has associated with these flocks, including both males and females.

Social system

- Males are territorial
  - Attack decoys
  - We have never seen 2 males together
- Males do not appear to exclude females
  - Females seen in 5 of 21 male home ranges

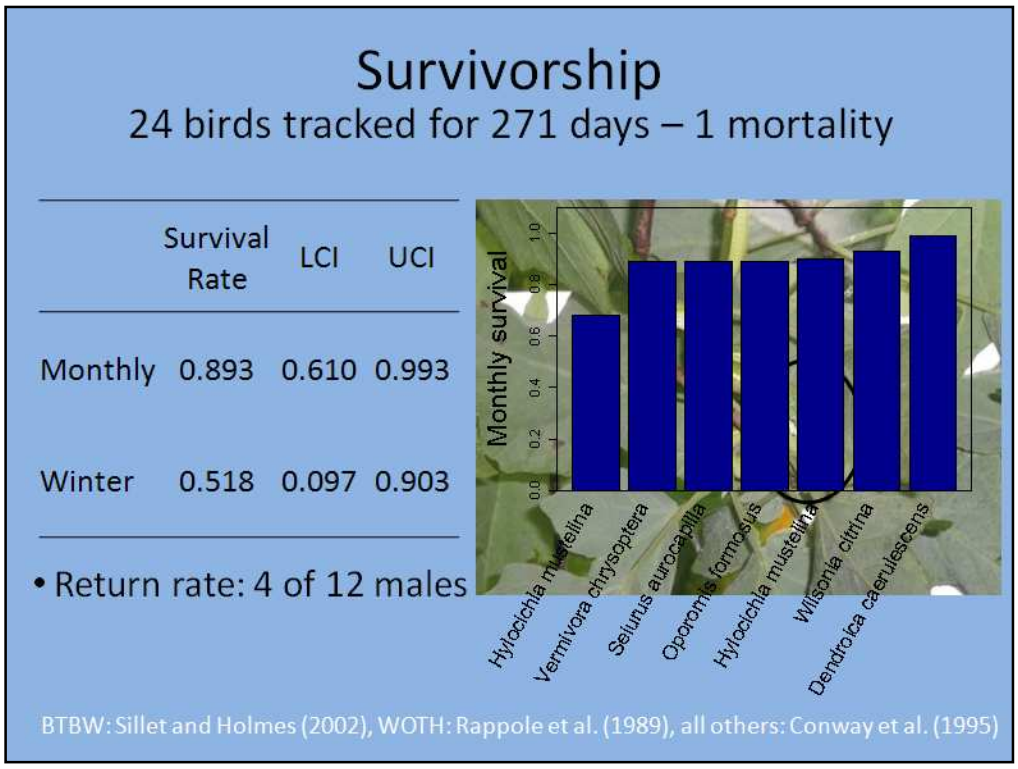
It didn't take too long to determine that males are territorial. The first bird we caught target-netting had clay and paint on his face from slamming into one of our decoys. You can see the hit this decoy took to the back of its head. This is a pretty typical response and we normally don't have any trouble catching males with decoys and broadcast vocalizations. Supporting evidence of territoriality includes the fact that we have never seen 2 males together. This wasn't too surprising, but what has been more interesting to observe is the apparent lack of direct competition between males and females. On several occasions we have seen them foraging side by side, which is something we haven't seen for males. This contrasts with species such as AMRE where males displace females.

Home range size

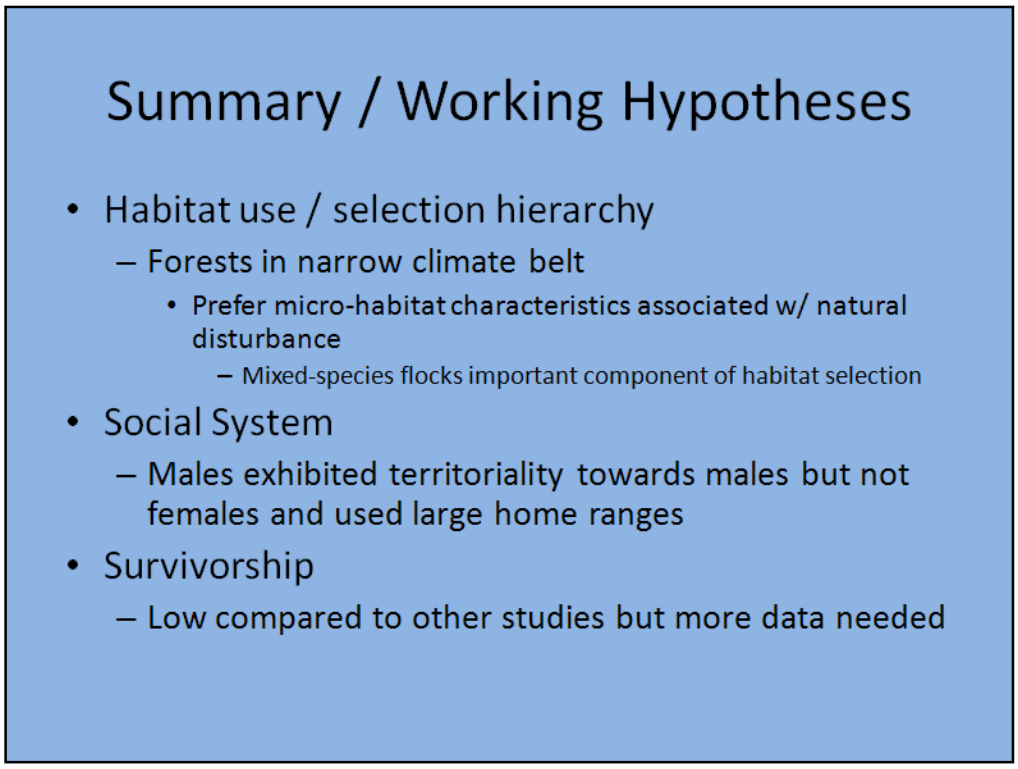


Utilization distribution	Mean (ha)	Min	Max
Minimum convex polygon	3.52	1.05	11.04
Kernel 50%	1.85	0.45	3.69
Kernel 95%	8.02	2.26	19.03

Radio-tracking GWWA can be challenging at times because, especially when they are flocking, they can move rapidly and they have large home ranges as can be seen here. On the left are kernel density estimates of utilization distributions for 18 individuals. An average home range size of 8 ha is quite large. For example, WIFL winter territory size was estimated to be <0.75 ha in Costa Rica, though Koronkiewicz et al. (2006) did not use radio-telemetry. You can also see the range for each of these 3 UDs is quite large as well, and we're currently investigating factors that affect home range size.



Estimating winter survivorship of GWWA poses challenges for several reasons. A mark-resight approach seems less than ideal because these birds have extremely low detection probabilities and do not occur at high densities. For example, we only get visual observations on tagged birds about 50% of the time. That is, even when we are within 20 m of them, they are often nearly impossible to see because of the nature of the topography or they are high up in the canopy. The use of playback could work for males but we find that they stop responding after several attempts. Finally, we are interested in more than apparent survival and would like to know what predators pose threats to this species. Therefore, the results I'm presenting today are based upon known-fate survival models from our telemetry data. We have so far 24 tracked birds for 271 days. The one mortality event we have witnessed was due to this striped-palm pit-viper *(Bothreicis lateralis).* You can see the bulge in his stomach. Our sample size is relatively small and as a consequence our confidence intervals are quite large, especially for the entire 6 month period. Nonetheless, we can say that this rate is much lower than the rate for one of the best studied NTMB, the BTBW. We used a Bayesian mode of analysis to generate this posterior distribution of winter survivorship, which allows us to determine the probability of the underlying survival rates being equal to rates reported for other NTMBs. For example, the probability of observing our survival data if the true survival rate was as high as BTWB is only 0.0008 despite our small sample size. Our estimate is much more comparable to those reported by Conway et al. for KEWA, WOTH, HOWO, and OVEN, which they found to be surprisingly low. We hope to double our sample size over the next 2 seasons, which should greatly increase the precision of this estimate. I also want to mention that 4 of 12 color-banded males have returned to their previous year's territrories. This is also within the normal range reported for other NTMBs.



I'd like to summarize and present some of our working hypotheses that we will be investigating further. It appears as though GWWA select habitat in a hierarchical manner in which they are constrained to forests within a narrow climate belt. Within this habitat type, they appear to select micro-habitat characteristics associated with disturbance. They also may be reliant on the presence of their favored foraging substrates as well as mixed-species flocks. The social system of wintering GWWA appears to involve intra-sexual territoriality, but little or no inter-sexual territoriality. Finally, our estimate of overwinter survival is quite low in comparison to other studies, but we need more data to increase the precision of this estimate.

Conservation Implications

170,000 ha forest lost since 1990

- Forest-dependence and specialized habitat requirements make Golden-winged Warblers sensitive to deforestation
- High propensity towards flocking make Golden-winged Warblers vulnerable to fragmentation.
- Territoriality and large home ranges mean large areas of habitat are required
- Low density = low carrying capacity
- Human altered forests may be low quality habitat but more survival data is needed

The bigger point that I hope to convey is that each of these aspects of GWWA non-breeding ecology make them vulnerable to land use change and deforestation to some extent. The UN food and agriculture organization reports that Costa Rica has lost 170,000 ha of forest since 1990. As most of you know, Costa Rica has one of the best conservation records in Latin America. The forests in our study area continue to be cut, even though they are officially protected and we have watched several areas with GWWA be deforested. This is concerning for several reasons. Specific causes for concern include:…

I'd like to finish by acknowledging the following groups and people…questions.